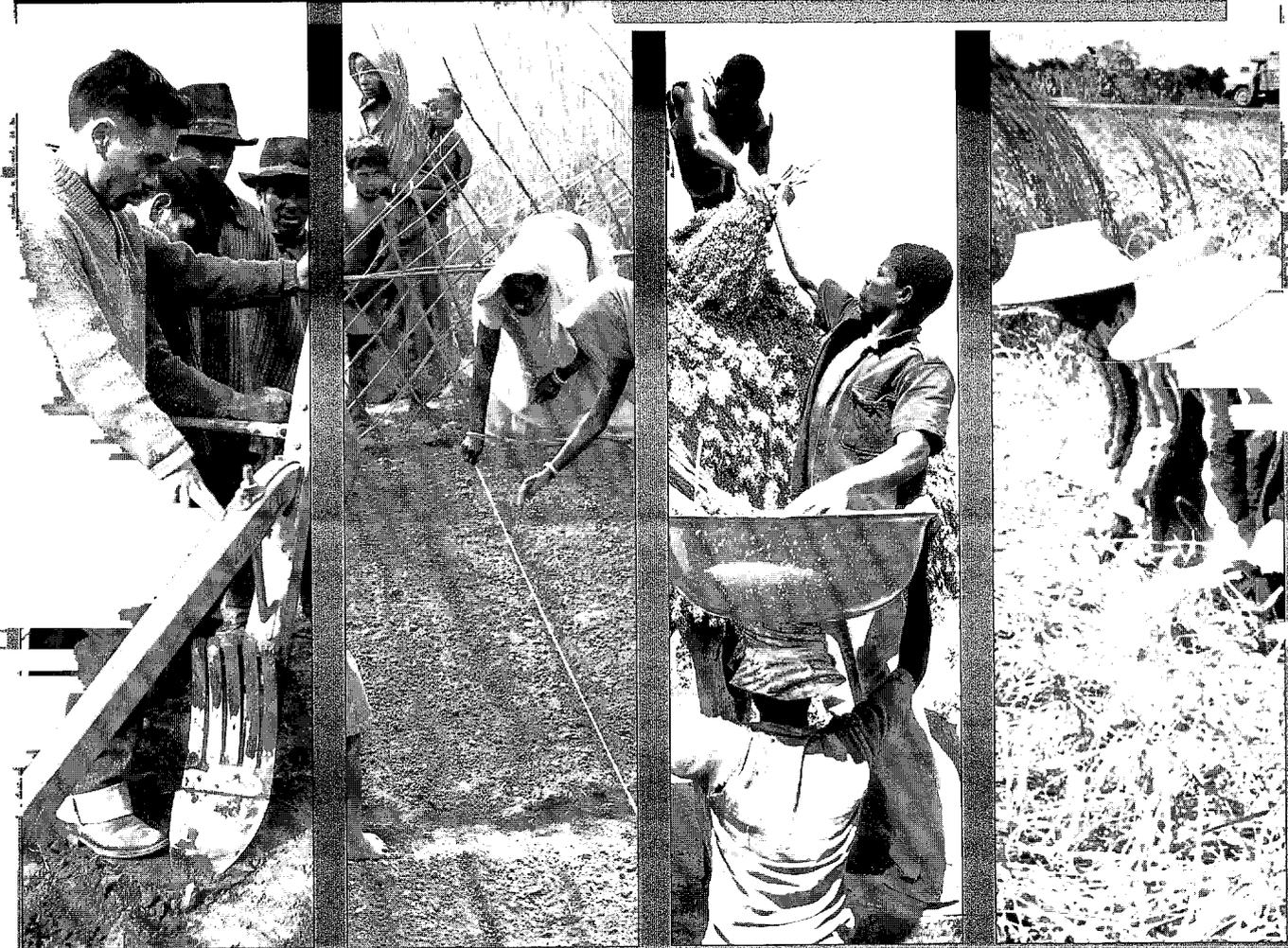


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# FOREIGN ASSISTANCE TO AGRICULTURE: A WIN-WIN PROPOSITION

PER PINSTRUP-ANDERSEN  
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2020

FOOD POLICY REPORT  
THE INTERNATIONAL FOOD  
POLICY RESEARCH INSTITUTE

**INTERNATIONAL  
FOOD  
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INSTITUTE**

The International Food Policy Research Institute was established in 1975 to identify and analyze alternative national and international strategies and policies for meeting food needs of the developing world on a sustainable basis, with particular emphasis on low-income countries and on the poorer groups in those countries.

While the research effort is geared to the precise objective of contributing to the reduction of hunger and malnutrition, the factors involved are many and wide-ranging, requiring analysis of underlying processes and extending beyond a narrowly defined food sector. The Institute's research program reflects worldwide collaboration with governments and private and public institutions interested in increasing food production and improving the equity of its distribution. Research results are disseminated to policymakers, opinion formers, administrators, policy analysts, researchers, and others concerned with national and international food and agricultural policy.

IFPRI is a member of the Consultative Group on International Agricultural Research and receives support from Australia, Belgium, Canada, Centre de coopération internationale en recherche agronomique pour le développement (CIRAD), China, Denmark, Food and Agriculture Organization of the United Nations, Ford Foundation, France, German Agency for Technical Cooperation (GTZ), German Federal Ministry for Economic Cooperation (BMZ), India, Inter-American Development Bank, International Development Research Centre (Canada), International Fund for Agricultural Development, Japan, Netherlands, Norway, Overseas Development Institute, the Philippines, Rockefeller Foundation, Spain, Sweden, Switzerland, United Kingdom, United Nations Development Programme, United Nations Children's Fund, United States, and the World Bank.

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## PREFACE

Moves are currently under way in some industrialized countries to reduce foreign aid. Although such cuts will undoubtedly retard economic growth and social development in developing countries, donor governments inevitably evaluate their foreign aid programs not only as altruistic activities, but also as political and economic investments. This report demonstrates that assistance can achieve both humanitarian and more self-interested objectives.

With expected unfortunate consequences for long-term economic and social development, assistance to agriculture by bilateral and multilateral donors declined significantly during the 1980s and early 1990s. The decline occurred in spite of evidence that agricultural growth makes significant contributions to overall economic growth.

One reason for the decline in assistance to agriculture was the opposition of farm groups in the donor countries. Many of these groups believed that agricultural assistance to developing countries would take away export markets.

This report looks more closely at this assertion. It shows that, in fact, agricultural assistance in the form of agricultural research expands developing-country imports from the world market. This is because agricultural research does more than increase agricultural production. The rise in agricultural production boosts incomes within and outside agriculture, which increases demand for other goods and services. This increases economic growth, and more growth leads to more imports. Ultimately, the value of the additional imports actually exceeds the initial investment in research.

Assistance to agriculture causes export opportunities for donor countries to expand, not decline. At the same time, assistance contributes to economic development in the recipient country. Foreign aid to agriculture is a win-win proposition.

This report comes out of ongoing IFPRI research on the important issue of aid to agriculture and forms part of IFPRI's broader mission of reducing hunger around the world.

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## THE POTENTIAL REWARDS OF FOREIGN ASSISTANCE

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Aid to developing countries for long-term development is currently being squeezed from all sides. Several donor countries are reviewing their foreign assistance programs, and a few, including the United States and Canada, are cutting back on such assistance. At the same time, with limitations on total aid, the increasing need for emergency relief in many developing countries reduces the funds available for long-term development assistance. It is widely recognized that these decreases in development assistance will reduce economic growth and human well-being in developing countries, exacerbating poverty, food insecurity, and malnutrition as well as raising health and mortality risks. Less well recognized, however, are the likely effects on the donor countries themselves: increasing international instability, mounting pressures on donor-country borders from people fleeing poverty and environmental degradation, rising health and environmental risks for the populations of donor countries, and reduced employment and economic growth in donor countries due to lost opportunities for exports.

This report addresses one of these effects: the link between foreign assistance to agriculture and export opportunities for donors of such assistance. The evidence shows that foreign assistance can effectively expand export earnings and associated employment in donor countries. If foreign assistance is properly targeted to activities that promote broad-based income growth in rural areas of developing countries, such as agricultural research, the gains to donor countries can be very large. IFPRI research shows that each dollar invested in agricultural research for developing countries generates \$4.39 of additional imports by these countries. This dollar also leads to an

increase of \$1.06 in agricultural imports and \$0.45 in cereal imports.

While expanded export opportunities do not assure that a particular donor country expands exports, all donors have the potential to increase exports and employment. This potential is especially great for countries that depend heavily on developing countries for their exports. In the United States, for example, 40 percent of all exports and half of all agricultural exports go to developing countries.<sup>1</sup>

Developing-country markets are growing much faster than markets for exports in the industrial world. From 1990 to 1993, exports from the European Union to developing countries grew at an annual rate of 6.3 percent, and are now worth almost US\$300 billion a year. From 1990 to 1994, U.S. exports to developing countries rose by almost 40 percent, from US\$140 billion to US\$197 billion. This increase alone has created more than 1.1 million jobs in the United States.<sup>2</sup>

Developing countries are also important and rapidly expanding markets for agricultural exports from industrial countries. About 20 percent of agricultural exports from developed market economies go to developing countries, and these exports are increasing by almost 6 percent a year.<sup>3</sup> Growth in U.S. agricultural exports to developing countries over the next few years is expected to average 9 percent a year, almost twice the growth of sales to developed countries.<sup>4</sup> Given the strong relationship between effective foreign assistance and export opportunities, cuts in foreign assistance are likely to increase unemployment in donor countries.

Aid donors have sometimes hesitated to support agriculture because they fear that rising production in developing countries will lower donor countries' agricultural exports.

Research and real-world experience show just the opposite. This report examines the reason for the paradoxical finding that assistance to agriculture that leads to agricultural growth increases overall and agricultural imports by developing countries. Step by step, it estimates the effects of agricultural research on agricultural growth, of agricultural growth on overall economic growth,

and of overall economic growth on total, agricultural, and cereal imports. It then calculates the value of additional imports created by foreign assistance to agricultural research. The analysis shows that foreign assistance is not a drain on the national treasuries of donor countries, but rather a win-win proposition for both donor and recipient.

## AGRICULTURAL RESEARCH INCREASES PRODUCTIVITY AND GROWTH

Public investment in agricultural research has returned generous rewards, consistently outperforming other types of investment projects. A 1986 study of foreign aid estimated that the rate of return to agricultural research, in terms of the value of additional agricultural output, is generally two to three times higher than the return to other agricultural investments, which themselves compare favorably with private investments.<sup>5</sup> Another study found that 63 agricultural research projects from 1906 to 1977 averaged an annual rate of return of more than 50 percent.<sup>6</sup> Still other studies have reported similar results.<sup>7</sup>

A striking example of the large returns produced by aid to agricultural research is the case of the Green Revolution. In the 1960s, many experts feared that the stagnation of agricultural production and the

increase of Asia's population would lead to widespread famine there. In response, governments and private foundations funded agricultural research to improve seeds and farming techniques. This investment, together with, among other things, better policies and infrastructure, led to the so-called Green Revolution. As a result, agricultural yields and production in Asia increased dramatically. Without this assistance, Asia's political stability might have been threatened and the developed countries would surely have been called on to help Asia feed her hungry. This experience demonstrates that assistance to agricultural research from developed countries can play a crucial role in energizing the agricultural sector and, as will be shown in the next section, the overall economy.

## AGRICULTURAL GROWTH LEADS TO ECONOMIC GROWTH

Despite the high rates of return to investment in agriculture, many policymakers and economic experts have thought of agriculture as an isolated backwater. They believed that higher returns to public investment could be had by promoting urban-based industrialization. Others felt that agriculture's contribution to growth could never amount to much because, they believed, it had few links to other sectors of the economy. In their view, agriculture was important mostly as a provider of low-cost food for urban workers, which helped to keep wages low, and as a source of government revenue.<sup>8</sup> History, as well as recent research, shows that these views are mistaken.

In fact, agriculture is a major contributor to overall economic growth. In developing

countries with the lowest per capita gross national product (GNP), agricultural production alone provides almost three-quarters of total employment, nearly half of gross domestic product (GDP), and more than half of all export earnings (Table 1). Among higher-income developing countries, similar figures apply for the food and agricultural system as a whole (that is, including the producers, processors, and distributors).

Although the relative contribution of agriculture to the economy declines as the economy develops, growth in agriculture and the overall economy actually go hand-in-hand. If agriculture is not productive, its lack of dynamism can drag down the entire economy, especially in least-developed countries where agriculture is a large sector.

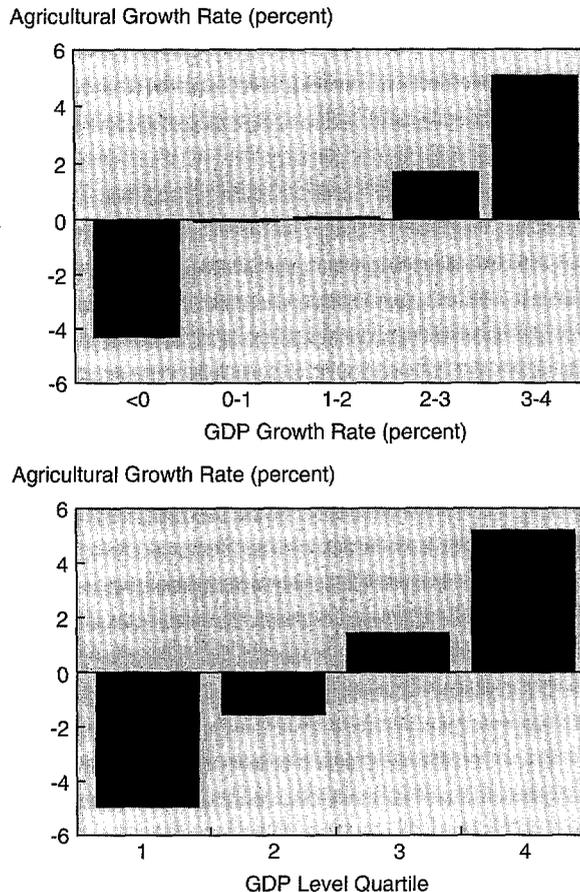
**Table 1—The role of agriculture in developing countries, 1989-91**

By Income Class	Annual Average for 1989-91
<b>Lowest quartile</b>	
Per capita GNP (US\$)	209.0
Share of agriculture in GDP (percent)	42.6
Share of labor force in agriculture (percent)	75.3
Share of agriculture in exports (percent)	54.4
<b>Lower middle quartile</b>	
Per capita GNP (US\$)	448.0
Share of agriculture in GDP (percent)	29.4
Share of labor force in agriculture (percent)	58.7
Share of agriculture in exports (percent)	40.2
<b>Upper middle quartile</b>	
Per capita GNP (US\$)	927.0
Share of agriculture in GDP (percent)	19.4
Share of labor force in agriculture (percent)	44.0
Share of agriculture in exports (percent)	44.8
<b>Highest quartile</b>	
Per capita GNP (US\$)	3,308.0
Share of agriculture in GDP (percent)	12.0
Share of labor force in agriculture (percent)	22.5
Share of agriculture in exports (percent)	34.1

Source: Food and Agriculture Organization of the United Nations and World Bank data tapes.

Note: Data include only non-oil-exporting developing countries. Per capita GNP is in 1987 U.S. dollars.

**Figure 1—Average agricultural growth rates in developing countries with different GDP growth rates and income levels, 1971-91**



Source: Computed by authors on the basis of World Bank and Food and Agriculture Organization of the United Nations data tapes.

Note: Data include only non-oil-exporting developing countries. Additional analyses performed for the periods 1971-80 and 1981-91 showed the same pattern.

As Figure 1 shows, when agricultural growth rates are high, overall growth rates are also high.

The effects of agricultural growth multiply throughout the economy. In Sub-Saharan Africa, for instance, each additional dollar of income from agriculture adds \$2 to \$3 to the overall economy.<sup>9</sup>

How does \$1 of income end up adding more than twice that amount to the economy? The effect of that dollar ripples through the economy as it changes hands. Increased

agricultural production leads to greater demands for supplies and services. As agricultural production expands, businesses that supply fertilizer, equipment, and repair services do too.<sup>10</sup> Processing, distribution, and storage activities must expand and become more complex to handle the increase in production. Employment increases as well.

Many studies fail to consider the important effects of agricultural growth on consumption. As a result of the increase in production and employment, the incomes of farmers and agricultural workers rise. They buy more. The increased demand then leads to growth in sectors other than agriculture. Studies of Malaysia and Sub-Saharan Africa found that about 70 to 80 percent of the additional economic activity generated by agricultural growth is due to these consumption, rather than production, effects.<sup>11</sup>

A study by Romeo Bautista found that in countries where agriculture constituted 20 percent or more of all economic activity, a 10 percent increase in the value of agricultural production led to a 13 percent increase in the value of nonagricultural production.<sup>12</sup> Other studies have also shown that the effects of agricultural growth on the economy, expressed as the value of additional economic growth generated by a \$1 increase in agricultural output, consistently exceed \$1. In India, for example, a \$1 increase in the value of agricultural output produces from \$1.64 to \$1.83 of additional economic growth, according to various studies.<sup>13</sup> A study of several African countries gave results that range from \$1.96 for Niger to \$2.75 for Burkina Faso.<sup>14</sup> Other research shows similar results; the lowest figure for additional economic growth reported in the available studies is \$1.26 for Latin America.<sup>15</sup>

IFPRI research using data for 42 developing countries from 1970 to 1992 reveals that, on average, a \$1 increase in agricultural production generates \$2.32 of growth in the overall economy (Table 2).<sup>16</sup> This effect increases as growth rates or income levels rise.

**Table 2—Value of additional economic growth generated by a \$1 increase in value of agricultural output**

	Value of Additional Economic Growth
	(\$)
All countries	2.32
By region	
North Africa and West Asia	3.12
Sub-Saharan Africa	1.79
South Asia	1.17
East Asia and the Pacific	2.31
Latin America and the Caribbean	3.97
By GDP growth rate quartile	
Lowest	1.73
Lower middle	1.80
Upper middle	2.25
Highest	3.65
By GDP level quartile	
Lowest	1.43
Lower middle	1.86
Upper middle	2.32
Highest	4.21

Source: Authors' calculations, based on data from World Bank World Tables tapes.

Note: Data are for 42 developing countries. Countries were assigned to quartiles according to their average growth rate from 1970 to 1992 and average income level from 1989 to 1992.

## ECONOMIC GROWTH INCREASES IMPORTS

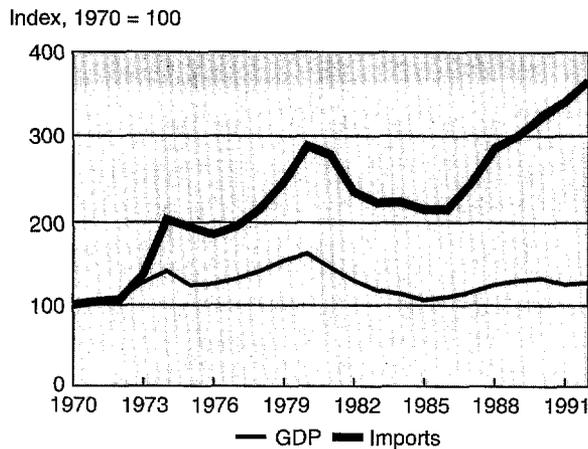
For countries with large rural, agriculturally based populations, a sound development strategy would focus on agriculture and rural areas. However, some policymakers and farmer groups in developed countries are concerned that by increasing agricultural production, such a strategy would cause agricultural exports from developed to developing countries to decline. But research shows that agriculture-based strategies actually lead developing countries to increase both their total imports and their agricultural imports.

### Incomes and Imports

Imports generally increase with a rise in incomes. As Figure 2 shows, between 1970 and 1981, per capita income in developing

countries increased and so did imports. After 1981, as per capita income declined, imports did too, although the fall in imports was less steep than the fall in per capita income. Since the mid-1980s, both per capita income and imports have rebounded. Figures 3 and 4 illustrate an even more dramatic positive relationship between the rate of economic growth and per capita imports. In 1970, countries in the fastest-growing quartile imported about 3 times more goods per capita than countries in the slowest-growing quartile. In 1992, they imported 25 times more. During this period, per capita imports by the faster-growing countries increased 500 percent, while per capita imports by the slower-growing countries declined. While per capita agricultural imports doubled in the countries with the

**Figure 2—Developing-country GDP and imports, per capita, 1970-92 (index based on constant dollars)**



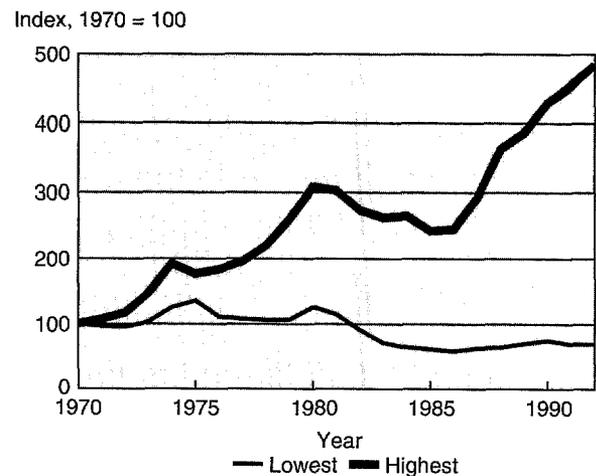
Source: Food and Agriculture Organization of the United Nations Trade Domain and World Bank World Tables.

highest growth rates, they fell in slower-growing countries (Figure 4). By 1992 the value of agricultural imports by these faster-growing countries was more than 10 times that of the slower-growing countries.

An alternative approach is to examine how a certain percentage increase in GNP would affect imports. Most studies have found that the percentage increase in imports would be greater than the percentage increase in GNP. Estimates for specific countries of the effect of a 10 percent increase in GNP on total imports range from 14.8 percent for Brazil to 36.4 percent for Singapore.<sup>17</sup> One study looked at developing countries as a whole in various years and found that, in response to a 10 percent rise in GNP, increases in food imports range from 5.3 percent to 10.1 percent and rises in cereal imports range from 8.6 percent to 10.6 percent.<sup>18</sup> A number of other studies confirm this positive relationship.<sup>19</sup>

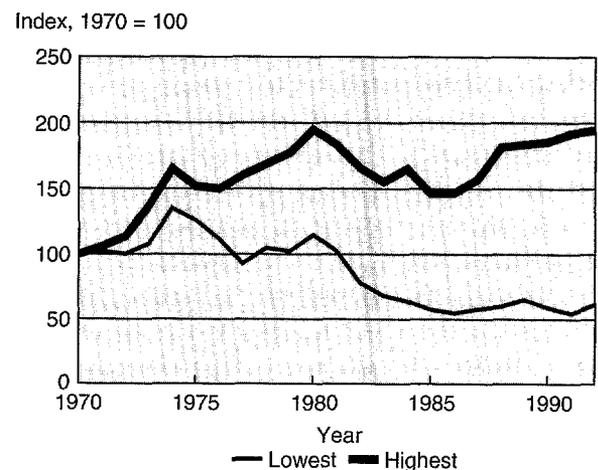
For U.S. exports, one study found that increasing annual growth rates in developing countries by 1 percent for five years increased the volume of feedgrain exports by 4.7 percent, wheat exports by 3.5 percent, and soybean exports by 2.8 percent.<sup>20</sup>

**Figure 3—Developing-country imports per capita, 1970-92: By GDP growth rate quartile, for lowest and highest quartile (index based on constant dollars)**



Source: Food and Agriculture Organization of the United Nations Trade Domain and World Bank World Tables.

**Figure 4—Developing-country agricultural imports per capita, 1970-92: By GDP growth rate quartile, for lowest and highest quartile (index based on constant dollars)**



Source: Food and Agriculture Organization of the United Nations Trade Domain and World Bank World Tables.

Table 3 shows results from IFPRI research on how total imports, agricultural imports, and cereal imports vary with economic growth. Data from 60 developing countries for the period 1970 through 1992 show that an increase of \$1 in GDP causes imports to increase by \$0.32, agricultural

Table 3—Value of additional imports generated by a \$1 increase in the value of GDP

	Total Imports	Agricultural Imports	Cereal Imports
		(\$)	
All countries	0.32	0.07	0.03
By region			
North Africa and West Asia	0.18	0.03	-0.01
Sub-Saharan Africa	0.32	0.10	0.02
South Asia	0.10	0.01	0.15
East Asia and the Pacific	0.37	0.50	0.16
Latin America and the Caribbean	0.29	0.09	0.01
By GDP growth rate quartile			
Lowest	0.27	0.00	-0.01
Lower middle	0.23	0.15	0.06
Upper middle	0.33	0.03	0.01
Highest	0.37	0.15	0.01
By GDP level quartile			
Lowest	0.19	-0.04	-0.03
Lower middle	0.27	0.17	0.00
Upper middle	0.30	0.16	0.04
Highest	0.37	0.14	0.02

Source: Authors' calculations, based on World Bank World Tables and Food and Agriculture Organization of the United Nations Trade Domain tapes.

Note: Data are for 60 developing countries. Countries were assigned to quartiles according to their average growth rate from 1970 and 1992 and average income level from 1989 to 1992.

imports to increase by \$0.07, and cereal imports to go up by \$0.03. Although the results vary by region and by income level, the relationship is always positive: an increase in income always increases imports. The effect of a change in GDP on overall imports increases if the country has a higher level of GDP or a higher growth rate. Agricultural imports do not seem to follow this trend so strongly, and in the poorest or slowest-growing countries, an increase in GDP would actually cause agricultural imports to decline.

### Agricultural Growth and Agricultural Imports

The data clearly show that in most cases imports, even agricultural and cereal imports, increase when GDP increases. But what if the economic growth results from increased agricultural production? Theoretically, increased domestic produc-

tion could displace agricultural imports. This is the potential outcome that worries agricultural producers in the donor countries. Empirical studies, however, consistently show that this concern is unfounded. Agricultural imports actually increase in developing countries when growth comes from the agricultural sector, for two reasons. First, as already explained, the effects of agricultural growth multiply through the economy. Incomes rise when domestic production increases, helping consumers to buy more of what they need. Demand expands along with, and usually faster than, production. The increase in production is not sufficient to meet all the expanded demand, and so agricultural imports increase.

Numerous studies support this conclusion. One study of 34 countries found that agricultural growth and agricultural imports increased together almost one-for-one.<sup>21</sup> Another found that even the 16 countries with the fastest growth in staple food pro-

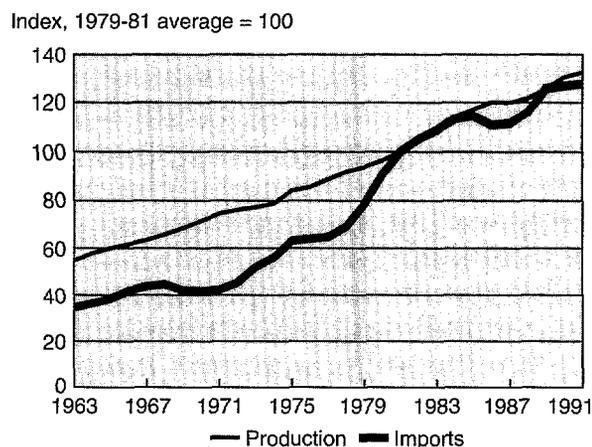
duction in the study sample doubled the volume of net food imports between 1961 and 1979.<sup>22</sup>

Other evidence shows that countries with rapid agricultural development boost their agricultural imports by significantly more than countries with lagging agricultural development.<sup>23</sup> Likewise, Earl Kellogg has shown that U.S. agricultural exports to countries that have implemented relatively successful agricultural development strategies have increased, while exports to countries with unsuccessful agricultural development strategies have declined.

Increases in incomes due specifically to technological improvements that raise agricultural productivity also lead to greater agricultural imports. James P. Houck examined data from 1983 and 1984 for 48 developing countries and found that an increase in agricultural productivity resulted in an equivalent percentage rise in per capita incomes and per capita food imports.<sup>24</sup> In a study of Indonesian agriculture, Kumaresan Govindan showed that the effect of technological change on income is significantly larger than its effect on production.<sup>25</sup> A 10 percent increase in agricultural productivity, for example, would lead to demand for agricultural products 50 percent larger than the initial increase in agricultural production. This excess demand would have to be satisfied by an increase in imports.

Cereals are often cited as a commodity in which increased developing-country production would have the greatest negative

**Figure 5—Cereal production and imports of developing countries: Three-year moving average (index based on constant dollars)**



Source: Food and Agriculture Organization of the United Nations.

consequences for developed-country exports. Yet developing-country imports and production of cereals have been increasing together in percentage terms since the early 1960s (Figure 5).

The second reason agricultural growth in developing countries increases their agricultural imports is based on geography. While some crops are grown in both developing and developed countries, many are not. For example, high-quality wheat is difficult or impossible to produce in many developing countries.<sup>26</sup> Thus, increased demand for wheat resulting from income growth is often reflected in larger imports.

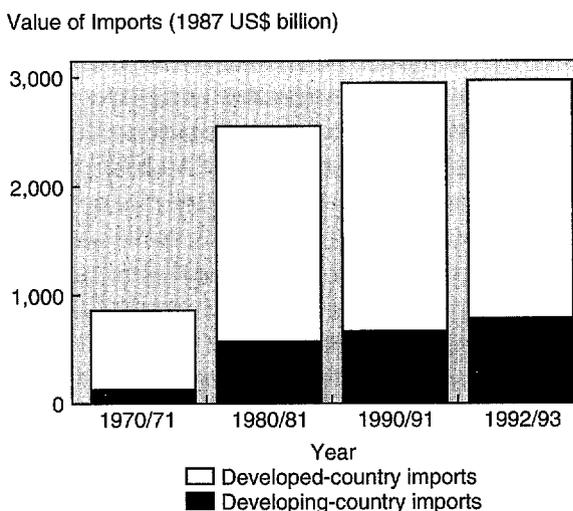
## IMPORTS INCREASE EXPORT-COUNTRY EMPLOYMENT

An increase in agricultural imports by one country is, of course, an increase in agricultural exports by another. These exports result in more jobs in the exporting country. Developing countries are a significant force behind the expansion in world trade, and exports to them are becoming increasingly important to developed-country economies. The share of world exports going to developing countries increased from 13 percent in 1970/71 to more than 26 percent in 1992/93, with the share growing at an average annual rate of about 3 percent (Figure 6). While developed-country imports have been falling at the rate of 1 percent a year in real terms during the 1990s, imports by developing countries have been increasing by more than 5 percent annually.

These exports provide significant employment in the developed-country economies. In the United States, every US\$1 billion of exports creates 20,000 jobs.<sup>27</sup> With annual exports to developing countries of US\$197 billion, the United States has almost 4 million jobs that depend on sales to developing countries. Exports from all developed-country economies in 1993 to developing countries totaled more than US\$728 billion, which, if the U.S. figure holds for other developed countries, would have created more than 14 million jobs in those countries.<sup>28</sup>

Although in an agriculturally based economy, an agriculturally oriented strategy is often the best way to generate widespread economic growth, international aid agencies sometimes hesitate to direct resources to agriculture for fear of antagonizing producer associations in donor countries. In the United States in the 1980s, for example, political support for assistance to agriculture weakened during the 1980s as a

Figure 6— Value of world and developing-country imports, 1970-93



Source: International Monetary Fund Direction of Trade Statistics, various years.

Note: All values are averages of two years.

result of a decline in U.S. agricultural exports. Some producer associations attributed this decline to foreign assistance given to agriculture in developing countries.<sup>29</sup>

Little evidence exists to support this view. During the 1970s, low support prices for export commodities combined with a devalued dollar to make U.S. exports very attractive in the world market. The United States also had idle productive capacity, which allowed it to respond quickly to increased demand at little cost. As a result, U.S. producers captured virtually all the 10 million tons of annual growth in world grain trade.<sup>30</sup>

In 1981 the U.S. Federal Reserve, the country's central bank, implemented a restrictive monetary policy that increased the value of the dollar on the world market. International prices of U.S. grain increased, and within five years world demand for U.S. agricultural exports fell by 40 percent,

resulting in billions of dollars of losses for U.S. farmers.<sup>31</sup>

Some argued that the decline in exports was due to technology transfers funded by the United States that allowed producers, such as Brazilian soybean growers, to increase production and take away U.S. market share. In reality, the total amount of U.S. assistance specifically targeted to Brazilian soybeans was less than \$1 million, and at the time of the decline no new soybean varieties developed under U.S.-Brazilian cooperation were being used commercially.<sup>32</sup>

The decline in U.S. agricultural exports to developing countries was principally a U.S. phenomenon, and was not caused by foreign assistance. Although U.S. agricultural exports to developing countries declined in the early 1980s, worldwide agricultural exports to developing countries increased. The declining world market share of U.S. products was not due to lower overall agricultural imports by developing countries. Today, exports to developing countries are actually an increasing share of total U.S. exports.<sup>33</sup>

## PUTTING THE PIECES TOGETHER

The evidence presented here shows that agricultural growth in low-income countries can lead to increases in overall growth and imports, specifically agricultural imports. When the pieces are put together, it is possible to quantify the effect of one component of an agricultural growth strategy—agricultural research—on the export market available for developed countries.

Drawing on earlier findings on the effects of agricultural growth on overall economic growth (Table 2) and the effects of economic growth on imports (Table 3), Table 4 shows the value of additional imports generated by a \$1 increase in agricultural growth. For all countries, on average, a \$1 increase in agricultural growth leads to an increase of \$0.73 in the value of imports, of which \$0.17 is agricultural imports, and \$0.07 cereal imports.

The results vary across regions and income levels, although in all cases agricultural growth increases overall imports. As suggested by previous results, the responsiveness of agricultural or overall imports to changes in agricultural growth is greater at higher rates of growth or higher levels of GDP.

The value of additional imports generated each year by a \$1 increase in agricultural research (Table 5) can then be determined by quantifying the effect of agricultural research on agricultural growth. Assuming a 40 percent annual return to agricultural research in terms of agricultural production,<sup>34</sup> on average, \$1 invested in agricultural research leads to increases of \$0.29 in total imports, \$0.07 in agricultural imports, and \$0.03 in cereal imports.

The figures discussed so far only give the additional imports for one year resulting from investment in agricultural research, but the increases in agricultural production generated by new agricultural technologies continue for many years. When the flow of additional imports is taken into account, the \$1 investment in agricultural research generates \$4.39 of additional imports over time (Table 6).<sup>35</sup> Although additional imports are generated in every region, the value of additional imports is smallest in South Asia. Table 3 shows that this is primarily because increases in GDP have a smaller effect on imports in South Asia: each \$1 increase in GDP results in only 10 cents more of imports. As the South Asian economies

**Table 4—Value of additional imports generated annually by a \$1 increase in agricultural output**

	Total Imports	Agricultural Imports	Cereal Imports
		(\$)	
All countries	0.73	0.17	0.07
By region			
North Africa and West Asia	0.57	0.11	0.02
Sub-Saharan Africa	0.57	0.18	0.04
South Asia	0.12	0.01	0.17
East Asia and the Pacific	0.84	1.16	0.36
Latin America and the Caribbean	1.13	0.36	0.04
By GDP growth rate quartile			
Lowest	0.47	0.00	0.02
Lower middle	0.41	0.27	0.11
Upper middle	0.74	0.07	0.03
Highest	1.35	0.54	0.04
By GDP level quartile			
Lowest	0.26	0.05	0.05
Lower middle	0.51	0.32	0.00
Upper middle	0.70	0.37	0.09
Highest	1.54	0.58	0.07

Source: Authors' calculations, based on Tables 2 and 3.

Note: Data are for 60 developing countries. Countries were assigned to quartiles according to their average growth rate from 1970 to 1992 and average income level from 1989 to 1992.

**Table 5—Value of additional imports generated annually by a \$1 increase in agricultural research**

	Total Imports	Agricultural Imports	Cereal Imports
		(\$)	
All countries	0.29	0.07	0.03
By region			
North Africa and West Asia	0.23	0.04	0.01
Sub-Saharan Africa	0.23	0.07	0.02
South Asia	0.05	0.01	0.07
East Asia and the Pacific	0.34	0.46	0.15
Latin America and the Caribbean	0.45	0.14	0.01
By GDP growth rate quartile			
Lowest	0.19	0.00	0.01
Lower middle	0.16	0.11	0.04
Upper middle	0.29	0.03	0.01
Highest	0.54	0.22	0.01
By GDP level quartile			
Lowest	0.11	0.02	0.02
Lower middle	0.20	0.13	0.00
Upper middle	0.28	0.15	0.04
Highest	0.62	0.23	0.03

Source: Authors' calculations, based on Tables 2 and 3.

Note: Data are for 60 developing countries. Countries were assigned to quartiles according to their average growth rate from 1970 to 1992 and average income level from 1989 to 1992.

**Table 6—Value of imports generated by \$1 in agricultural research in the long term**

	Total Imports	Agricultural Imports	Cereal Imports
		(\$)	
All countries	4.39	1.06	0.45
By region			
North Africa and West Asia	3.48	0.61	0.15
Sub-Saharan Africa	3.48	1.06	0.30
South Asia	0.76	0.15	1.06
East Asia and the Pacific	5.15	6.96	2.27
Latin America and the Caribbean	6.81	2.12	0.15
GDP growth rate quartile			
Lowest	2.88	0.00	0.15
Lower middle	2.42	1.67	0.61
Upper middle	4.39	0.45	0.15
Highest	8.18	3.33	0.15
GDP level quartile			
Lowest	1.67	0.30	0.30
Lower middle	3.03	1.97	0.00
Upper middle	4.24	2.27	0.61
Highest	9.39	3.48	0.45

Source: World Bank World Tables and Food and Agriculture Organization of the United Nations Trade Domain tapes.

Note: Data are for 60 developing countries. Countries were assigned to quartiles according to their average growth rate from 1970 to 1992 and average income level from 1989 to 1992. Value of imports is calculated for a 30-year period (based on Phil Pardey, personal communication, 1994).

become more open to trade, this value should increase. Consequently, the value of additional imports resulting from agricultural research should rise. The value of additional imports in other regions ranges from \$3.48 to \$6.81. Outside of South Asia, agricultural research would return far more to the world economy through increased imports than the initial investment.

Even more imports are generated where countries are growing fastest or are relatively better off. As Table 6 shows, the fastest-growing countries import almost three times more than the slower-growing ones. And the wealthier countries generate over five times more imports than the poorest countries. Table 2 suggests that this difference is primarily due to the fact that agricultural growth imparts a greater boost to overall growth in faster-growing and wealthier countries.

Table 6 also includes results for agricultural and cereal imports. Overall, for \$1 invested in agricultural research, an addi-

tional \$1.06 of agricultural imports and \$0.45 of cereal imports are generated. The effect in both cases is strongest in East Asia and the Pacific because growth in GDP has a much larger effect on agricultural imports there than in any other region (Table 3). For agricultural imports, South Asia again demonstrates the weakest regional response. More rapidly growing countries and more developed countries generate more agricultural imports than slower-growing countries or less-developed countries, but the pattern for cereal imports is weaker (Table 6).

Even if investments in agricultural research yielded annual returns far lower than the 40 percent average used here, such investments would still generate significant additional imports over their lifetimes. Table 7 shows that an average annual return of only 10 percent would be sufficient to generate an additional dollar's worth of exports for each dollar invested in developing-

**Table 7—Annual returns to a \$1 investment in agricultural research necessary to generate \$1 in additional imports**

	Annual Return
	(percent)
All countries	10
By region	
North Africa and West Asia	12
Sub-Saharan Africa	12
South Asia	58
East Asia and the Pacific	8
Latin America and the Caribbean	6
By GDP growth rate quartile	
Lowest	15
Lower middle	17
Upper middle	9
Highest	5
By GDP level quartile	
Lowest	27
Lower middle	14
Upper middle	10
Highest	5

Source: World Bank World Tables and Food and Agriculture Organization of the United Nations Trade Domain tapes.

Note: Data are for 60 developing countries. Annual returns to investment are in terms of agricultural output.

Countries were assigned to quartiles according to their average growth rate from 1970 to 1992 and average income level from 1989 to 1992.

country agricultural research. Returns could even be as low as 5 or 6 percent a year, as in Latin America and the Caribbean or in the cases of high growth rates or high levels of GDP.

The evidence indicates that donor countries can benefit from increased agricultural

output in developing countries by competing for the increased demand for imports that results from such growth. Donor investments in productivity-enhancing agricultural research will yield positive returns for donor countries in the form of new exports.

## CONCLUSION

Although altruism plays an important part, it is probably not unfair to say that most donors allocate foreign aid primarily according to political, economic, and security interests.

This report focuses on a relatively small, but important, part of that assistance. It shows that assistance to agriculture can further the interests of both donor and recipient countries. The presumptions underlying the criticisms of foreign aid to agriculture are unfounded.

Policymakers and researchers once thought that agriculture had few links to the rest of the economy and so agriculture would not stimulate growth in other sectors. Subsequent research showed that agriculture could indeed be an "engine of growth" for development.

In the debate over conflicts between aid, agricultural growth, and trade, the links of agriculture with other economic sectors have once again been forgotten, and discussion has focused almost exclusively on what happens to agricultural supply when agriculture grows. But the story does not end with the increases in production that result from agricultural research. Incomes and demand for goods and services from other sectors also rise. Imports, even agricultural imports, increase. For each dollar of assistance to agricultural research for developing countries, the export market available for donor countries expands by more than four dollars, of which more than one dollar is for agricultural commodities. Seen in this light, foreign assistance to agriculture is a win-win proposition.

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## NOTES

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2. International Monetary Fund, *Direction of Trade Statistics Yearbook* (Washington, D.C.: IMF, 1994).
3. United Nations, *Handbook of International Trade and Development Statistics* (New York: United Nations, 1993).
4. World Bank, *Common Interests: The United States and the World Bank* (Washington, D.C.: World Bank, 1995).
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7. A study of 124 projects found similar rates of return (Rubén G. Echeverría, ed., *Methods for Diagnosing Research System Constraints and Assessing the Impact of Agricultural Research*, vol. 2, *Assessing the Impact of Agricultural Research* [The Hague: International Service for National Agricultural Research, 1990]). Another study by Robert Evenson reviewed the rates of return from over 100 studies. Only 1 of the studies had a negative return, and the highest annual return was more than 200 percent. Of the 92 research projects cited conducted by public or international agencies in developing countries, more than half (49) had annual returns greater than 50 percent, another 28 projects yielded returns between 30 and 50 percent, and 8 (less than 10 percent of the sample) had returns between 0 and 20 percent (Robert E. Evenson, *Research and Extension in Agricultural Development*, International Center for Economic Growth Occasional Paper No. 25 [San Francisco: ICS Press, 1992]).
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9. International Food Policy Research Institute, *Agricultural Growth Linkages in Sub-Saharan Africa: Summary of a Report to the U.S. Agency for International Development* (Washington, D.C.: International Food Policy Research Institute, 1994).
10. Hans Binswanger, *The Economics of Tractors in South Asia* (New York and Hyderabad, India: Agricultural Development Council and the International Crops Research Institute for the Semi-Arid Tropics, 1978).

11. Clive Bell, Peter Hazell, and Roger Slade, "The Prospects for Growth and Change in the Muda Project Region, Malaysia," in *Village-Level Modernization in Southeast Asia*, ed. Geoffrey B. Hainsworth (Vancouver, Canada: University of British Columbia Press, 1982); Steven Haggblade, Peter Hazell, and James Brown, "Farm-Nonfarm Linkages in Sub-Saharan Africa," *World Development* 17, no. 8 (1989): 1173-1201.
12. Romeo Bautista, "Domestic Terms of Trade and Agricultural Growth in Developing Countries," in *The Balance between Industry and Agriculture in Economic Development*, ed. Nurul Islam, vol. 5, *Factors Influencing Change* (London: Macmillan, 1989). Similarly, Alain de Janvry and Elisabeth Sadoulet found that a 10 percent increase in agricultural output led to a 14 percent rise in manufacturing output ("The Conditions for Compatibility between Aid and Trade in Agriculture," *Economic Development and Cultural Change* 37, no. 1, [1988]: 1-30).
13. For India, Peter Hazell and Steven Haggblade found a value of \$1.64 (*Rural-Urban Growth Linkages in India*, PRE Working Paper No. 430 [Washington, D.C.: World Bank, 1990]). C. Rangarajan found a value of \$1.70 (*Agricultural Growth and Industrial Performance in India* [Washington, D.C.: International Food Policy Research Institute, 1992]). Peter Hazell, C. Ramasamy, and V. Rajagopalan found a value of \$1.83 ("An Analysis of the Indirect Effects of Agricultural Growth on the Regional Economy," in *The Green Revolution Reconsidered: The Impact of High-Yielding Rice Varieties in South India*, ed. Peter Hazell and C. Ramasamy [Baltimore, Md., U.S.A.: Johns Hopkins University Press, 1991]).
14. Christopher Delgado et al., "Agricultural Growth Linkages in Sub-Saharan Africa," report to the U.S. Agency for International Development (Washington, D.C.: International Food Policy Research Institute, 1994). Other results from this study were \$1.97 for Senegal and \$2.48 for Zambia.
15. The figure for Latin America comes from Steven Haggblade and Peter Hazell, "Agricultural Technology and Farm-Nonfarm Growth Linkages," *Agricultural Economics* 3, Special Issue, International Agricultural Research Systems (1989): 345-364. This study also found values ranging from \$1.28 to \$1.47 for Africa and \$1.38 to \$1.74 for Asia. Other reported values are \$1.50 for Nigeria and Sierra Leone and \$2.81 specifically for Gusau, Nigeria (Steven Haggblade, Peter Hazell, and James Brown, "Farm-Nonfarm Linkages in Sub-Saharan Africa"). For Muda, Malaysia, one study found a value of \$1.83 (Bell, Hazell, and Slade, "The Prospects for Growth and Change"). Another study found a value of \$1.71 for Muda, Malaysia, as well as \$1.35 for rural Sierra Leone (Steven Haggblade, Jeffrey Hammer, and Peter Hazell, "Modeling Agricultural Growth Multipliers," *American Journal of Agricultural Economics* 73, no. 2 [1991]: 361-374). A study by Paul Dorosh and Steven Haggblade reported values ranging from \$1.80 to \$2.70 for Madagascar (Agriculture-led Growth Linkages in Madagascar," *Agricultural Economics* 9, no. 2 [August 1993]).
16. This figure represents only the first-round, direct effects of a change in agricultural income on overall income. It does not incorporate indirect effects, like those mentioned earlier on consumption. In technical terms, this number represents the marginal effect rather than the total multiplier effect.

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17. Erkin I. Bairam, "Income Elasticities of Exports and Imports: A Re-examination of the Evidence," *Applied Economics* 25, no. 1 (January 1993): 71-74. Other results from this study were Colombia, 19.1 percent; Indonesia, 27.7 percent; Pakistan, 29.0 percent; the Philippines, 24.2 percent; Syria, 23.7 percent; and Thailand, 19.4 percent.
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  19. Khwaja Sarmad, "The Determinants of Import Demand in Pakistan," *World Development* 17, no. 10 (1989): 1619-1625. This study showed that Pakistan's total imports would rise by 6.3 percent and imports of oils and fats would rise by 14.2 percent in response to a 10 percent rise in GNP. Khwaja Sarmad and Riaz Mahmoud conducted another study of Pakistan and found the following results: imports of milk and cream would rise 42.1 percent; spices, 16.0 percent; fresh fruits, 13.8 percent; and tea, 59.4 percent ("Price and Consumer Elasticities of Consumer Goods Imports in Pakistan," *Pakistan Development Review* 24, nos. 3-4 [1985]: 453-460). A study of the increase in rice imports in response to a 10 percent increase in GNP showed these results: India, 103.2 percent increase; Korea, 27.2 percent; Malaysia, 3.4 percent; Pakistan, 50.5; the Philippines, 11.8 percent; and Sri Lanka, 9.7 percent (Badrul Islam, "Price, Income, and Foreign Exchange Reserve Elasticity for Asian Rice Imports," *American Journal of Agricultural Economics* [August 1978]: 532-535). Desmond F. McCarthy, Lance Taylor, and Cyrus Talati found that in 55 developing countries merchandise imports would rise 10.3 percent in response to a 10 percent rise in GNP ("Trade Patterns in Developing Countries," *Journal of Development Economics* 27, nos. 1-2 [October 1987]: 5-39).
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31. Robert Thompson, "Farm, Trade, and Development Policies: What They Mean for Future U.S. Export Markets," in *Aid, Trade, and Farm Policies: Workshop Proceedings*, ed. Wayne E. Swegle and Polly Ligon (Washington, D.C.: Winrock International, 1989); and Robert Havener and Christopher Dowswell, "Food Production in the Third World and Implications for U.S. Agriculture," in *U.S. Agriculture and Third World Economic Development: Critical Interdependency* (Washington, D.C.: National Planning Association, 1987).
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33. Earl D. Kellogg, "Agricultural Development in Developing Countries and Changes in U.S. Agricultural Exports," undated.
34. Forty percent is a conservative estimate based on results cited earlier in Cassen and Associates, *Does Aid Work?*; Ruttan, *Agricultural Research Policy*; and Echeverría, *Methods for Diagnosing Research System Constraints*.
35. This figure represents the value in terms of additional imports to the typical agricultural research project with a 40 percent annual rate of return over its lifetime, assumed to be 30 years, discounted at a real rate of interest of 5 percent.

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